

NBSIR 78-
13 39

INTERLABORATORY PROGRAMS FOR RUBBER

ANALYSES NO. 35
JANUARY - MARCH 1978



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NBS COLLABORATIVE REFERENCE PROGRAMS

TAPPI Paper and Board (6 times per year)

Bursting strength	Smoothness
Tearing strength	Surface pick strength
Tensile breaking strength	K & N ink absorption
Elongation to break	pH
Tensile energy absorption	Opacity
Folding endurance	Blue reflectance (brightness)
Stiffness	Specular gloss, 75°
Air resistance	Thickness
Grammage	Concora (flat crush)
	Ring crush

FKBG-API Containerboard (48 times per year)

Mullen burst of linerboard
Concora test of medium

MCCA Color and Appearance (4 times per year)

Gloss at 60°
Color and color difference
Retroreflectivity

Rubber (4 times per year)

Tensile strength, ultimate elongation and tensile stress
Hardness
Mooney viscosity
Vulcanization properties

ASTM Textiles (3 times per year)

Flammability (FF3-71 and FF5-74)

ASTM Cement (2 times per year)

Chemical (11 chemical components)
Physical (8 characteristics)

AASHTO Bituminous

Asphalt cement (2 times per year)
Cutbacks (once a year)



Collaborative Reference Programs
B360 Polymer Building
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Washington, D.C. 20234

INTERLABORATORY PROGRAMS FOR RUBBER

Analyses No. 35
January - March 1978

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U. S. DEPARTMENT OF COMMERCE
National Bureau of Standards

NBSIR 78-1339

INTRODUCTION

This report summarizes the test results for the first quarter of 1978. The tests cover the four areas in the NBS Collaborative Reference Programs for Rubber: Tensile Properties, Hardness, Mooney Viscosity, and Vulcanization Properties.

For each of the four areas, there is a set of summary tables followed by a table of data and analysis by laboratory and a graphical presentation of the data and analysis. Where applicable, the tables of data have the English and Metric expressions side-by-side. Additional details are given in the section "Key to Tables and Graphs."

If there are questions or comments on the notes, the analyses, or the reports in general, contact Edwin B. Randall, Jr., Jeffrey Horlick, or Jeffrey Stevenson, (301) 921-2946.

A handwritten signature in cursive script that reads "Edwin Randall". The signature is written in dark ink and is positioned above the typed name and title.

Edwin B. Randall, Jr., Administrator
NBS Collaborative Reference Programs
Office of Testing Laboratory Evaluation Technology

June 12, 1978



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KEY TO TABLES AND GRAPHS

LAB CODE	Confidential laboratory identification number known only to the participant and the Collaborative Reference Program staff.
F	A flag identifying results that are extreme in comparison with the other results.
X	- The plotted point for the indicated laboratory lies outside of the 99% error ellipse (not shown); ie, assuming normal distribution, 99% of laboratories similar to those participating in the program will be represented by points lying within the 99% ellipse.
*	- The plotted point for the indicated laboratory lies outside of the 95% error ellipse shown on graphs, but inside the 99% ellipse.
MEAN	The arithmetic average of the two median values for the two sheets or samples of the same material.
% DEV	The deviation or difference of the laboratory MEAN from the GR. MEAN (see below), expressed as a percent of the GR. MEAN.
REL SDR	The ratio of the SDR (standard deviation of replicate measurements within a laboratory) to the AVER SDR (see below). Extreme values, ie, values that are likely to occur by chance less than one time in a hundred as determined by the chi-square test, are marked with an "X".
VAR CODE	A code number designating a particular test instrument, set of environmental conditons, procedure, unit used, or other variation. The code "01" designates the instrument, conditions and procedure specified at the top of the page either explicitly or in the cited ASTM Standard, and the unit of test shown at the top of the first column of data. A '+' in front of the VAR CODE indicates that the data has been excluded from the grand means due to a non-standard variation of the possibilities mentioned above, or the data is extreme.
GR MEAN	The arithmetic average (grand mean) of all the laboratory MEAN values, excluding those flagged (F) with an "X".
SD MEANS	The standard deviation among the laboratory MEAN values included in the GR. MEAN.

AVR SDR The arithmetic average of all the standard deviations of within laboratory replication, excluding those excluded from the GR. MEAN and excluding any additional ones for which the REL SDR has been flagged.

GRAPH

For each laboratory the MEAN for the second material is plotted against the MEAN for the first material, with each point representing a laboratory. The horizontal and vertical lines are the GR. MEAN values. The dashed line is drawn at 45°. The solid sloping line, which may or may not lie close to the 45° line, is the major axis of the ellipse. The ellipse is drawn so that, on the average, it will include 95% of the points representing the laboratories. The plotted symbols X and * used to represent results falling outside the ellipse are explained under "F" above. Laboratories inside the ellipse (no flag in the F column) are plotted as an O.

The graph is plotted with an ellipse when there are 20 or more laboratories in the analysis. When there are 10 through 19 laboratories in the analysis, the graph is plotted but the ellipse is omitted. When there are fewer than 10 laboratories retained in the Grand Mean the graph is not plotted.

For development of the theory, see the paper by J. Mandel and T.W. Lashof, Interpretation and Generalization of Youden's Two-Sample Diagram, J. of Quality Technology, Vol. 6, pp 22-36, Jan. 1974.

SUMMARY OF ANALYSES

LABS INCL Number of laboratories included in the GR. MEANS.

LABS OMIT Number of laboratories reporting data but excluded from the GR. MEANS.

STANDARD DEVIATIONS

LABS Same as the SD MEANS (see above)

SHEETS Standard deviation between the two sheets or samples of the same material.

REPL Same as AVR SDR (see above)

PRECISION OF METHODS

REPL CRP The number of replicate measurements per sheet or sample, as specified in the Collaborative Reference Program.

REPL ASTM The number of replicate measurements specified for a test result in the designated ASTM Standard.

REPEAT The repeatability, a measure of the within laboratory precision, i.e., of the ability of the test technician to repeat his test result: two test results obtained by the same technician on the same homogeneous sample of material may be expected 95% of the time to agree within the repeatability.

REPROD The reproducibility, a measure of the between laboratory precision: two test results obtained in different laboratories may be expected 95% of the time to agree within the reproducibility.

ABSOLUTE Values of REPEAT and REPROD expressed in the units of measurement.

PERCENT Values of REPEAT and REPROD expressed as a percent of the GR. MEANS.

NOTES

Materials A81 and A82 were sheets of the same vulcanized rubber. Similarly, materials A83 and A84 were alike.

V200 results were obtained at NBS using an electronic tester, V100 results were obtained at NBS using an pendulum tester.

All participants used Die C in ASTM D412 with the following exceptions:

V120 used ASTM Die B
V126 used Die 2 in BS903
V208 did not specify a Die
V213 used ASTM Die D

Electronic testers were used by 39 (64%) of the 61 participants; pendulum testers were used by 19 participants; 3 participants did not specify either type. Elongation measurements were made by automatic devices by 22 (36%) participants and manually by the rest. There were 9 (15%) reported relative humidities above 55% and 27 (44%) reported relative humidities below 45%.

SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LA8S	LA8S	GR. MEAN	STD DEVIATIONS			UNITS
		INCL	OMIT		LA8S	SHEETS	REPL	
TENSILE STRENGTH	A81-A82	60	1	2657.	124.	59.	72.	POUNDS PER SQUARE INCH
	A83-A84	60	1	3725.	242.	155.	286.	POUNDS PER SQUARE INCH
TENSILE STRENGTH	A81-A82	60	1	18.32	.85	.41	.50	MEGAPASCALS
	A83-A84	60	1	25.69	1.67	1.13	1.97	MEGAPASCALS
ULTIMATE ELONGATION	A81-A82	58	3	621.	22.	10.	17.	PERCENT
	A83-A84	58	3	681.	25.	13.	32.	PERCENT
STRESS AT 300% ELONGATION	A81-A82	59	2	1148.	62.	16.	26.	POUNDS PER SQUARE INCH
	A83-A84	59	2	1013.	61.	20.	30.	POUNDS PER SQUARE INCH
STRESS AT 300% ELONGATION	A81-A82	59	2	7.916	.429	.111	.178	MEGAPASCALS
	A83-A84	59	2	6.989	.419	.135	.210	MEGAPASCALS

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL	REPL	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
		CRP	ASTM		REPEAT	REPROD		REPEAT	REPROD
TENSILE STRENGTH	A81-A82	5	5	2657.	200.	343.	PSI	7.5	12.9
	A83-A84	5	5	3725.	792.	671.	PSI	21.3	18.0
TENSILE STRENGTH	A81-A82	5	5	18.32	1.38	2.36	MEGAPA	7.5	12.9
	A83-A84	5	5	25.69	5.46	4.62	MEGAPA	21.3	18.0
ULTIMATE ELONGATION	A81-A82	5	5	621.	47.	61.	%	7.6	9.8
	A83-A84	5	5	681.	88.	69.	%	13.0	10.2
STRESS AT 300% ELONGATION	A81-A82	5	5	1148.	71.	172.	PSI	6.2	15.0
	A83-A84	5	5	1013.	84.	168.	PSI	8.3	16.6
STRESS AT 300% ELONGATION	A81-A82	5	5	7.916	.493	1.187	MEGAPA	6.2	15.0
	A83-A84	5	5	6.989	.582	1.160	MEGAPA	8.3	16.6

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
TENSILE STRENGTH - POUNDS PER SQUARE INCH

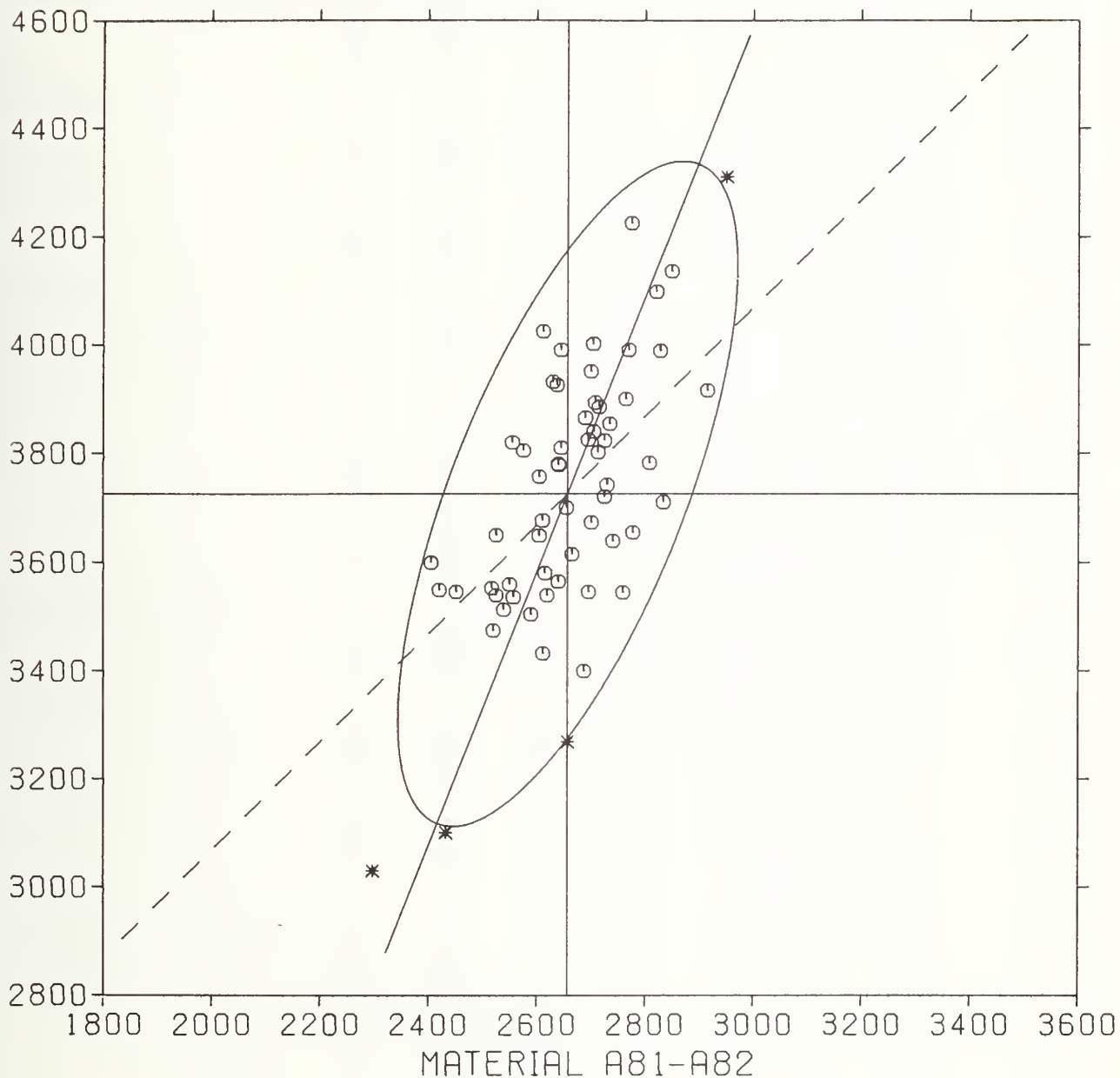
JANUARY 1979

LAB CODE	F	MATERIAL A81-A82 COMMERCIAL TIRE TREAD				MATERIAL A83-A84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MEAN PSI	MEAN MEGAPA	% DEV	REL SDR		
V0076		2740.	18.90	3.1	1.04	3640.	25.10	-2.3	1.40	01	
V0078		2615.	18.03	-1.6	.63	3580.	24.69	-3.9	1.48	01	
V0081		2612.	18.02	-1.7	1.43	4025.	27.76	8.0	.87	01	
V0083		2525.	17.41	-5.0	.64	3650.	25.17	-2.0	.57	01	
V0084		2695.	18.59	1.4	.59	3825.	26.38	2.7	.72	01	
V0085		2611.	18.00	-1.7	.71	3677.	25.36	-1.3	1.38	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		2590.	17.86	-2.5	1.11	3505.	24.17	-5.9	1.45	01	
V0088		2420.	16.69	-8.9	.76	3550.	24.48	-4.7	.96	01	
V0092		2620.	18.07	-1.4	1.32	3540.	24.41	-5.0	1.32	01	
V0095		2700.	18.62	1.6	1.00	3950.	27.24	6.0	1.28	01	
V0096		2612.	18.01	-1.7	.83	3432.	23.67	-7.9	1.01	01	
V0100		2690.	18.55	1.2	1.21	3865.	26.66	3.7	.90	01	
V0111		2770.	19.10	4.3	1.04	3990.	27.52	7.1	.64	01	
V0117		2645.	18.24	-1.5	1.24	3990.	27.52	7.1	.98	01	
V0120	*	2657.	18.32	.0	.85	3268.	22.54	-12.3	.95	01	
V0122		2405.	16.59	-9.5	1.01	3600.	24.83	-3.4	1.71	01	
V0123		2735.	18.86	2.9	1.05	3855.	26.59	3.5	.74	01	
V0126		2821.	19.46	6.2	.94	4097.	28.26	10.0	.49	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		2665.	18.38	.3	.89	3615.	24.93	-3.0	.82	01	
V0141		2808.	19.37	5.7	1.52	3782.	26.09	1.5	1.08	01	
V0144A		2915.	20.10	9.7	.56	3915.	27.00	5.1	1.21	01	
V0144B		2655.	18.31	-1.1	.93	3700.	25.52	-7.7	1.28	01	
V0145		2517.	17.36	-5.3	.60	3553.	24.51	-4.6	1.17	01	
V0148		2775.	19.14	4.4	2.14X	4225.	29.14	13.4	1.19	01	
V0149		2730.	18.82	2.7	.93	3742.	25.81	.4	1.31	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0150		2705.	18.66	1.8	.90	3840.	26.48	3.1	.94	01	
V0151		2604.	17.96	-2.0	.90	3649.	25.17	-2.1	1.49	01	
V0152		2850.	19.66	7.3	1.80	4135.	28.52	11.0	1.17	01	
V0153		2555.	17.62	-3.8	1.36	3820.	26.34	2.5	.83	01	
V0154		2520.	17.38	-5.2	.72	3475.	23.97	-6.7	1.12	01	
V0156		2765.	19.07	4.1	1.20	3900.	26.90	4.7	.87	01	
V0158		2777.	19.15	4.5	1.15	3655.	25.21	-1.9	1.66	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0159		2525.	17.41	-5.0	1.27	3540.	24.41	-5.0	.69	01	
V0160		2640.	18.21	-1.6	.82	3555.	24.59	-4.3	.76	01	
V0166		2713.	18.71	2.1	.36	3802.	26.22	2.1	1.57	01	
V0168		2834.	19.54	6.7	2.71X	3710.	25.59	-1.4	1.01	01	
V0169		2451.	16.90	-7.7	.56	3546.	24.46	-4.8	.90	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0176		2645.	18.24	-1.5	.75	3810.	26.28	2.3	.84	01	
V0177		2760.	19.03	3.9	1.29	3545.	24.45	-4.8	1.11	01	
V0178		2715.	18.72	2.2	2.36X	3885.	26.79	4.3	.83	01	
V0184		2630.	18.14	-1.0	.51	3931.	27.11	5.5	.63	01	
V0190		2640.	18.21	-1.6	1.01	3778.	26.06	1.4	.62	01	
V0199		2696.	18.60	1.5	1.67	3546.	24.46	-4.8	.79	01	
V0200		2704.	18.65	1.8	1.75	4001.	27.60	7.4	.76	01	
V0206		2550.	17.59	-4.0	.86	3550.	24.55	-4.4	.40	01	
V0207	*	2950.	20.34	11.0	1.18	4310.	29.72	15.7	.82	01	
V0208		2828.	19.51	6.4	.72	3989.	27.51	7.1	.91	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0213		2700.	18.62	1.6	1.16	3673.	25.33	-1.4	.67	01	
V0214		2725.	18.79	2.6	1.28	3823.	26.37	2.6	1.13	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220	X	2800.	19.31	5.4	.72					01	
V0223		2725.	18.79	2.6	1.56	3720.	25.66	-1.1	1.29	01	
V0224		2605.	17.97	-2.0	2.36X	3757.	25.91	.9	1.01	01	
V0232		2640.	18.21	-1.6	1.05	3780.	26.07	1.5	.73	01	
V0233		2708.	18.68	1.9	.56	3893.	26.85	4.5	.98	01	
V0235		2575.	17.76	-3.1	.55	3805.	26.24	2.1	.97	01	
V0238		2637.	18.19	-1.7	.87	3925.	27.07	5.4	1.77	01	
V0243		2557.	17.63	-3.8	1.01	3536.	24.39	-5.1	1.08	01	
V0244		2539.	17.51	-4.4	1.01	3513.	24.23	-5.7	.70	21	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A	*	2432.	16.77	-8.5	1.99X	3100.	21.38	-16.8	.78	01	
V0245B	*	2297.	15.84	-13.5	.98	3029.	20.89	-18.7	.71	01	
V0250		2687.	18.53	1.1	1.40	3400.	23.45	-8.7	1.97X	01	
		2657.	18.32	= GR. MEAN =		3725.	25.69				5 TEST DETERMINATIONS
		124.	.85	= SD MEANS =		242.	1.67				60 LABORATORIES IN GRAND MEANS
		72.	.50	= AVER SDR =		286.	1.97				61 LABORATORIES REPORTING
		PSI	MEGAPA	= UNIT =		PSI	MEGAPA				

TENSILE STRENGTH

MATERIAL A81-A82 2657. PSI MATERIAL A83-A84 3725. PSI

MATERIAL A83-A84



INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
ULTIMATE ELONGATION - PERCENT

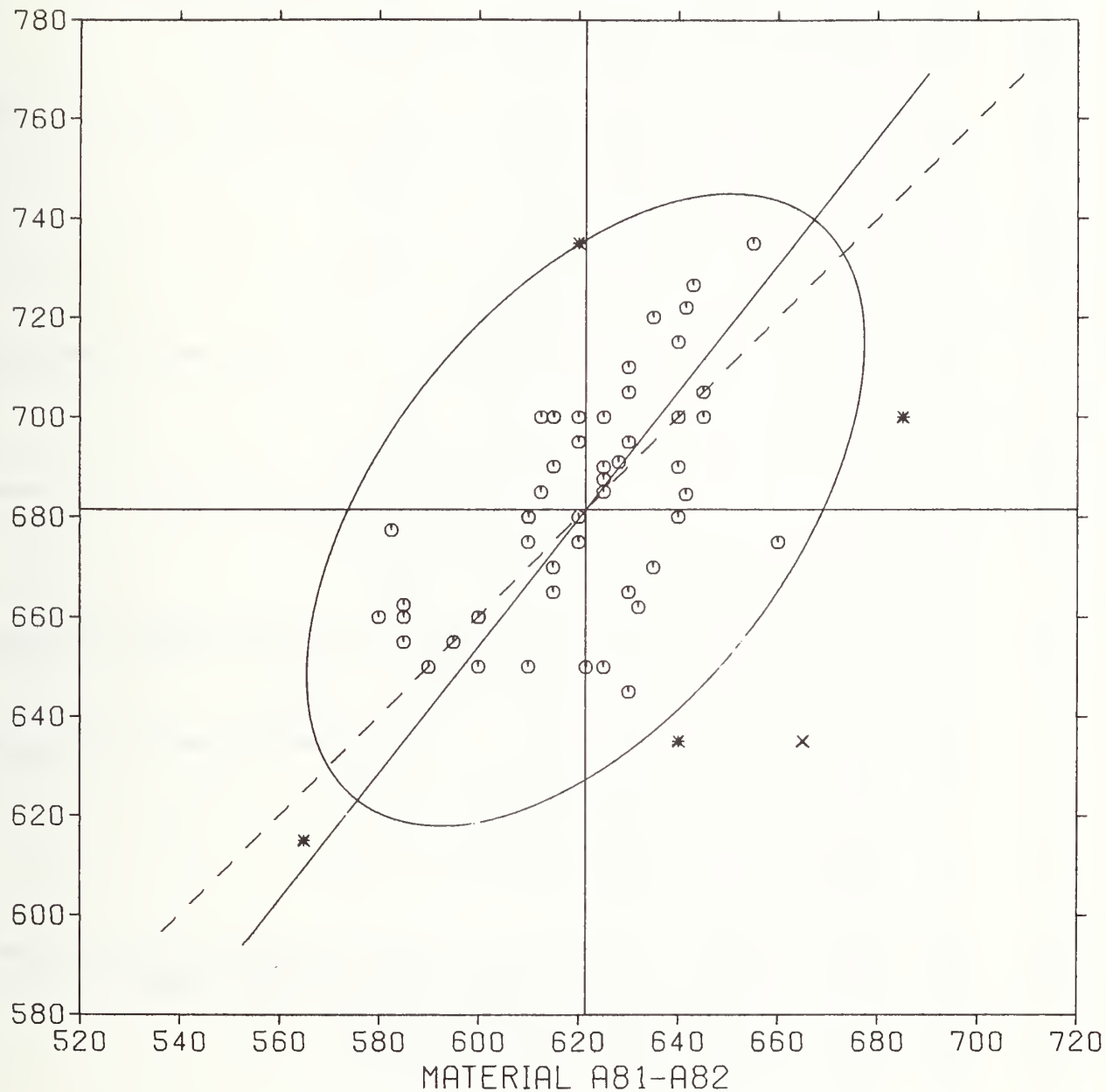
JANUARY 1978

LAB CODE	P	MATERIAL A81-A82 COMMERCIAL TIRE TREAD			MATERIAL A83-A84 SBR			VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN %	% DEV	REL SDR	MEAN %	% DEV	REL SDR		
V0076		625.	.6	1.20	650.	-4.6	1.51	01	
V0078		590.	-5.0	.93	650.	-4.6	1.81	01	
V0081		580.	-6.7	1.51	660.	-3.1	.77	01	
V0083		582.	-6.3	.65	677.	-4.6	.73	01	
V0084		610.	-1.8	.41	680.	-4.2	.82	01	
V0085		630.	1.4	.62	710.	4.2	1.43	01	
V0087		632.	1.7	1.80	662.	-2.9	1.59	01	
V0088		630.	1.4	1.34	665.	-2.4	.94	01	
V0092	*	565.	-9.1	1.13	615.	-9.7	1.17	01	
V0095		630.	1.4	1.15	695.	2.0	1.49	01	
V0096		621.	.0	1.27	650.	-4.6	1.22	01	
V0100		615.	-1.0	.92	700.	2.7	.49	01	
V0111		643.	3.5	1.28	726.	6.6	.77	01	
V0117		635.	2.2	.85	720.	5.7	1.15	01	
V0120	*	640.	3.0	.71	635.	-6.8	1.14	01	
V0122		640.	3.0	1.07	700.	2.7	1.89	01	
V0123		625.	.6	1.21	690.	1.3	.47	01	
V0126		641.	3.2	.81	722.	6.0	.46	01	
V0128		610.	-1.8	1.51	675.	-4.9	.67	01	
V0141		635.	2.2	1.29	670.	-1.7	.89	01	
V0144A		640.	3.0	.75	650.	1.3	1.14	01	
V0144B		620.	-4.2	.95	695.	2.0	.81	01	
V0146		645.	3.8	.85	705.	3.5	1.32	01	
V0148		625.	.6	1.13	700.	2.7	.55	01	
V0149		585.	-5.9	.98	662.	-2.8	.74	01	
V0150	X	625.	.6	.93	785.	15.2	1.27	01	
V0151		655.	5.4	1.64	735.	7.9	2.01X	01	
V0152		612.	-1.4	1.27	685.	.5	1.16	01	
V0153		612.	-1.4	1.46	700.	2.7	.78	01	
V0154		595.	-4.2	.59	655.	-3.9	1.18	01	
V0156		600.	-3.4	1.50	650.	-4.6	.60	01	
V0158	*	685.	10.2	1.01	700.	2.7	1.71	01	
V0159		615.	-1.0	1.45	565.	-2.4	.76	01	
V0160		610.	-1.8	.89	650.	-4.6	.63	01	
V0166		620.	-4.2	.26	700.	2.7	1.76	01	
V0168		630.	1.4	2.41X	645.	-5.3	.83	01	
V0169		585.	-5.9	.45	660.	-3.1	.87	01	
V0176		615.	-1.0	.93	670.	-1.7	.88	01	
V0177		660.	6.2	.91	675.	-4.9	1.19	01	
V0178		628.	1.1	2.40X	691.	1.4	.76	01	
V0184		620.	-4.2	.63	675.	-4.9	.87	01	
V0190		645.	3.8	.57	700.	2.7	.65	01	
V0199		660.	6.2	2.10X	675.	-4.9	1.07	01	
V0200		615.	-1.0	1.27	700.	2.7	.49	01	
V0206		640.	3.0	1.06	680.	-4.2	1.13	01	
V0207		615.	-1.0	.60	700.	2.7	.45	01	
V0208		600.	-3.4	.49	660.	-3.1	.78	01	
V0213		641.	3.2	1.22	684.	.4	.79	01	
V0214		640.	3.0	1.33	715.	4.9	1.52	01	
V0220	X	655.	5.4	.87				01	
V0223		620.	-4.2	1.22	680.	-4.2	1.37	01	
V0224	*	620.	-4.2	2.64X	735.	7.9	1.04	01	
V0232		615.	-1.0	.81	690.	1.3	.90	01	
V0233		600.	-3.4	.49	660.	-3.1	.82	01	
V0235		585.	-5.9	.58	655.	-3.9	.58	01	
V0238		625.	.6	.73	688.	.9	1.63	01	
V0243		625.	.6	.72	685.	.5	.88	01	
V0244		610.	-1.8	.71	680.	-4.2	.70	01	
V0245A		615.	-1.0	1.90	670.	-1.7	1.13	01	
V0245B		630.	1.4	1.00	705.	3.5	1.08	01	
V0250	X	665.	7.0	.21	635.	-6.8	1.99X	01	
		621.	GR. MEAN			681.	5 TEST DETERMINATIONS		
		22.	SD MEANS			25.	58 LABORATORIES IN GRAND MEANS		
		17.	AVER SDR			32.	61 LABORATORIES REPORTING		
		%	UNIT			%			

ULTIMATE ELONGATION

MATERIAL A81-A82 621. % MATERIAL A83-A84 681. %

MATERIAL A83-A84



LAB CODE	F	MATERIAL A81-A82 COMMERCIAL TIRE TREAD				MATERIAL A83-A84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN PSI	MEAN MEGAPA	% DEV	REL SDR	MEAN PSI	MEAN MEGAPA	% DEV	REL SDR		
V0076		1175.	8.103	2.4	.67	1040.	7.172	2.6	.65	01	
V0078		1179.	8.131	2.7	1.10	1031.	7.114	1.8	1.10	01	
V0081		1125.	7.759	-2.0	.75	1062.	7.328	4.8	.83	01	
V0083		1162.	8.017	1.3	.70	1050.	7.241	3.6	.85	01	
V0084		1165.	8.034	1.5	.60	1025.	7.069	1.1	.70	01	
V0085		1131.	7.802	-1.4	.39	972.	6.702	-4.1	.91	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0087		1155.	7.966	.6	.90	1060.	7.310	4.6	.96	01	
V0088		1070.	7.379	-6.8	2.06X	1030.	7.103	1.6	1.69	01	
V0092		1285.	8.862	12.0	1.23	1135.	7.828	12.0	1.05	01	
V0095		1175.	8.103	2.4	1.13	1090.	7.517	7.6	.93	01	
V0096		1158.	7.990	.9	1.09	1020.	7.038	.7	.83	01	
V0100		1140.	7.862	-.7	.98	990.	6.828	-2.3	1.26	01	
V0111		1165.	8.034	1.5	.67	1035.	7.138	2.1	.66	01	
V0117		1120.	7.724	-2.4	1.38	965.	6.655	-4.8	1.61	01	
V0120		1118.	7.714	-2.6	.56	1036.	7.148	2.3	1.49	01	
V0122	X	862.	5.948	-24.9	1.25	825.	5.690	-18.5	1.03	01	
V0123		1195.	8.241	4.1	.87	1050.	7.241	3.6	1.01	01	
V0126		1149.	7.927	.1	1.00	975.	6.727	-3.8	.74	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0128		1190.	8.207	3.7	.55	1040.	7.172	2.6	1.12	01	
V0141		1229.	8.476	7.1	.43	1037.	7.152	2.3	.49	01	
V0144A		1140.	7.862	-.7	1.39	950.	6.552	-6.3	.76	01	
V0144B		1140.	7.862	-.7	1.72	960.	6.621	-5.3	.85	01	
V0146	*	979.	6.752	-14.7	1.16	910.	6.276	-10.2	1.16	01	
V0148		1200.	8.276	4.5	.43	1087.	7.500	7.3	1.08	01	
V0149		1198.	8.262	4.4	.70	1053.	7.262	3.9	1.20	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0150		1125.	7.759	-2.0	.39	965.	6.655	-4.8	.53	01	
V0151		1105.	7.621	-3.7	2.34X	961.	6.631	-5.1	2.37X	01	
V0152		1210.	8.345	5.4	.38	1090.	7.517	7.6	.68	01	
V0153		1120.	7.728	-2.4	1.78	961.	6.628	-5.2	1.74	01	
V0154		1160.	8.000	1.1	.47	1035.	7.138	2.1	.81	01	
V0156		1225.	8.448	6.7	1.49	1055.	7.345	5.1	1.18	01	
V0158		1073.	7.402	-6.5	.98	943.	6.502	-7.0	.32	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0159		1110.	7.655	-3.3	1.00	1020.	7.034	.6	1.17	01	
V0160		1175.	8.103	2.4	.93	1070.	7.379	5.6	1.13	01	
V0166		1148.	7.921	.1	.78	973.	6.710	-4.0	.59	01	
V0168		1187.	8.186	3.4	1.30	1013.	6.990	.0	.90	01	
V0169		1131.	7.802	-1.4	1.13	1008.	6.952	-.5	1.17	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0175		1155.	7.966	.6	1.75	985.	6.793	-2.8	1.39	01	
V0177		1065.	7.345	-7.2	.74	940.	6.483	-7.2	1.20	01	
V0178		1135.	7.828	-1.1	.74	985.	6.793	-2.8	.63	01	
V0184		1067.	7.362	-7.0	.84	1025.	7.069	1.1	.47	01	
V0190		1153.	7.955	.5	1.55	976.	6.731	-3.7	1.04	01	
V0199		1123.	7.748	-2.1	1.77	1043.	7.197	3.0	1.86	01	
V0200		1107.	7.638	-3.5	.94	985.	6.797	-2.8	.54	01	
V0206		1110.	7.655	-3.3	1.37	1020.	7.034	.5	1.62	01	
V0207	*	1300.	8.966	13.3	1.81	1195.	8.241	17.9	1.09	01	
V0208		1226.	8.452	6.8	2.37X	1139.	7.852	12.3	2.11X	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0213		1140.	7.866	-.6	1.65	977.	6.741	-3.5	1.44	01	
V0214		1102.	7.602	-4.0	.56	914.	6.302	-9.8	1.00	20	ORIGINAL IN MEGANEWTONS PER SQ.METER
V0220		1150.	7.931	.2	.75	1000.	6.897	-1.3	.70	01	
V0223		1220.	8.414	6.3	.43	1025.	7.069	1.1	.97	01	
V0224		1180.	6.138	2.8	1.43	1000.	6.897	-1.3	1.08	01	
V0232		1155.	7.966	.6	1.16	1002.	6.914	-1.1	.89	01	
V0233		1212.	8.362	5.6	1.03	1057.	7.359	5.3	1.10	01	
V0235		1215.	8.379	5.9	.78	1110.	7.655	9.5	1.10	01	
V0238		1112.	7.672	-3.1	1.07	975.	6.724	-3.8	.63	01	
V0243		1013.	6.986	-11.7	.56	889.	6.131	-12.3	.72	01	
V0244		1088.	7.504	-5.2	1.50	981.	6.768	-3.2	1.21	21	ORIGINAL IN KILOGRAMS/SQ. CENTIMETER
V0245A	*	959.	6.617	-16.4	1.54	860.	5.934	-15.1	1.35	01	
V0245B	X	925.	6.379	-19.4	1.04	718.	4.955	-29.1	1.75	01	
V0250		1212.	8.362	5.6	.97	987.	6.810	-2.6	.82	01	
		1148.	7.916	-	GR. MEAN	1013.	6.989				5 TEST DETERMINATIONS
		62.	.429	-	SD MEANS	61.	.419				59 LABORATORIES IN GRAND MEANS
		26.	.178	-	AVER SDR	30.	.210				61 LABORATORIES REPORTING
		PSI	MEGAPA	-	UNIT	PSI	MEGAPA				

STRESS AT 300% ELONGATION

MATERIAL A81-A82

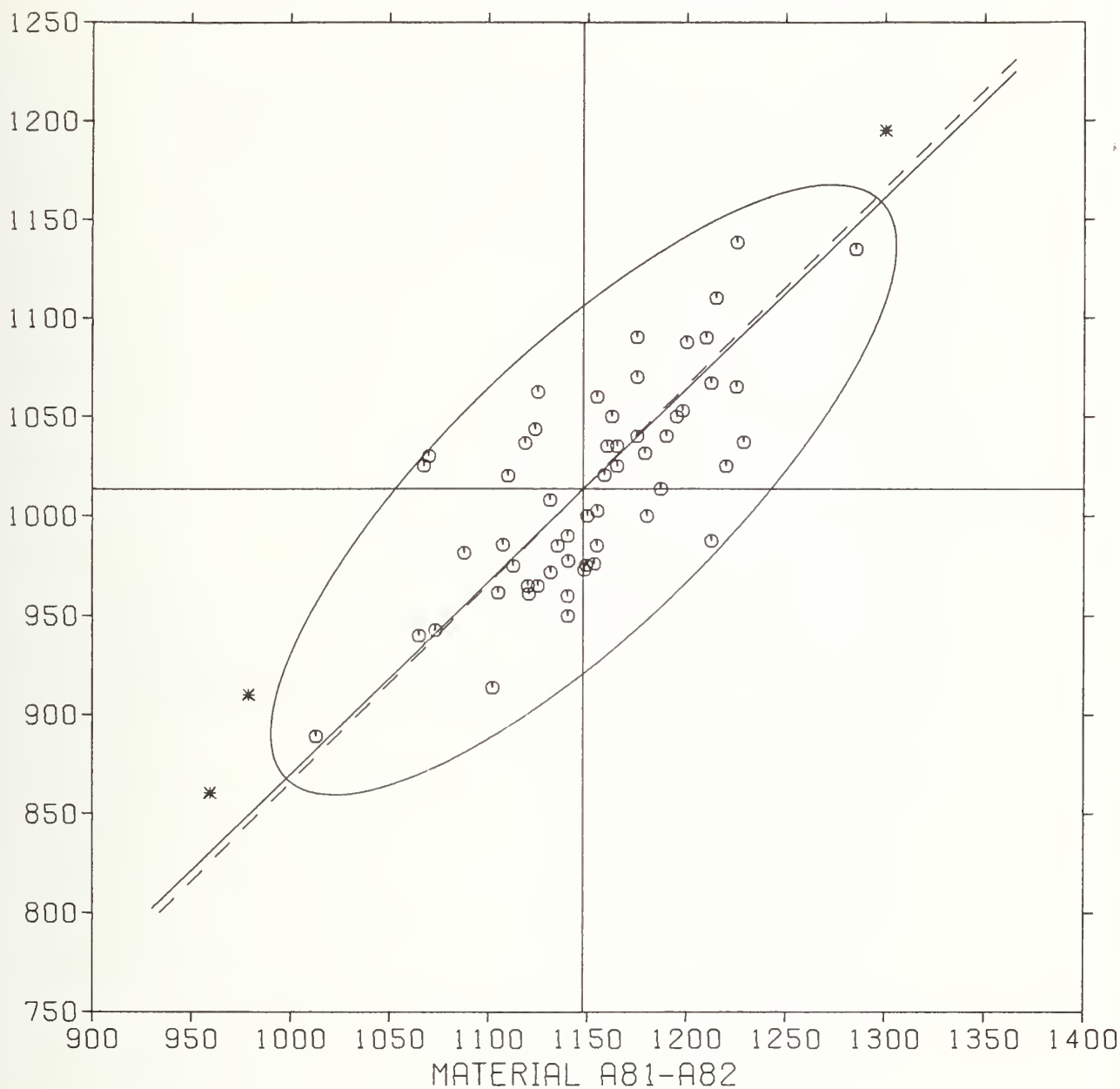
1148. PSI

MATERIAL A83-A84

1013. PSI

PSI

MATERIAL A83-A84





HARDNESS

NOTES

Materials A81 and A82 were sheets of the same vulcanized rubber. Similarly, materials A83 and A84 were alike.

V100 results were obtained at NBS using ASTM D2240. V200 results were obtained at NBS using ASTM D1415.

Four of the 26 participants reporting used ASTM D1415 (Wallace) for the hardness determination. All others used ASTM D2240 (Type A Durometer).

SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS			UNITS
					LABS	SHEETS	REPL	
HARDNESS	A81-A82	26	0	55.26	1.72	.18	.40	IRHD
	A83-A84	26	0	56.14	1.82	.20	.41	IRHD

PRECISION OF METHODS

PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
					REPEAT	REPROD		REPEAT	REPROD
HARDNESS	A81-A82	5	5	56.26	1.11	4.77	IRHD	2.0	8.5
	A83-A84	5	5	56.14	1.13	5.04	IRHD	2.0	9.0

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
HARDNESS - IRHD

JANUARY 1978

MATERIAL A81-A82				MATERIAL A83-A84				VAR	INSTRUMENT, UNIT, OR OTHER VARIATION
LAB	F	COMMERCIAL	TIRE TREAD	MEAN	%	REL	VAR		
C9DE		IRHD	DEV	SDR	IRHD	DEV	SDR	C9DE	
V0081		57.00	1.3	1.25	57.00	1.5	1.54	01	
V0084		57.50	2.2	.56	58.00	3.3	1.34	01	
V0085		55.35	-1.6	.48	53.80	-4.2	.59	01	
V0087		60.00	6.7	.56	60.00	6.9	.67	01	
V0088		55.50	-1.3	2.10X	57.00	1.5	1.10	01	
V0092		53.50	-4.9	1.37	54.50	-2.9	1.10	01	
V0095		55.50	-1.3	1.68	53.50	-4.7	1.22	01	
V0100		55.50	-1.3	.69	56.50	.6	1.22	01	
V0111		57.50	2.2	.69	58.00	3.3	1.10	01	
V0122		56.00	-.5	.62	55.25	-1.6	.95	01	
V0128		54.50	-3.1	1.37	55.50	-1.1	1.22	01	
V0141		53.00	-5.8	1.25	53.00	-5.6	.67	01	
V0144		59.50	5.8	1.61	58.50	4.2	2.41X	01	
V0144B		59.00	4.9	1.12	58.50	4.2	1.10	01	
V0168		57.25	1.8	.62	57.25	2.0	.77	01	
V0169		58.00	3.1	.56	58.00	3.3	.55	01	
V0176		56.50	.4	1.57	55.50	-1.1	1.34	01	
V0190		56.00	-.5	1.45	55.00	-.3	1.22	01	
V0200		54.00	-4.0	.51	53.25	-5.1	.53	01	
V0208		55.30	-1.7	1.28	54.20	-3.5	.67	01	
V0214		55.55	-1.3	2.91X	55.15	-1.8	1.12	01	
V0224		54.50	-3.1	1.25	55.50	-1.1	1.22	01	
V0232		57.00	1.3	.00	57.50	2.4	1.22	01	
V0235		56.25	-.0	.28	55.25	-1.6	.77	01	
V0243		56.50	.4	1.12	56.00	-.3	.67	01	
V0244		56.50	.4	1.12	57.00	1.5	1.10	01	
		56.26	= GR. MEAN =		55.14	5 TEST DETERMINATIONS 26 LABORATORIES IN GRAND MEANS 26 LABORATORIES REPORTING			
		1.72	= SD MEANS =		1.82				
		.40	= AVER SDR =		.41				
		IRHD	= UNIT =		IRHD				

HARDNESS

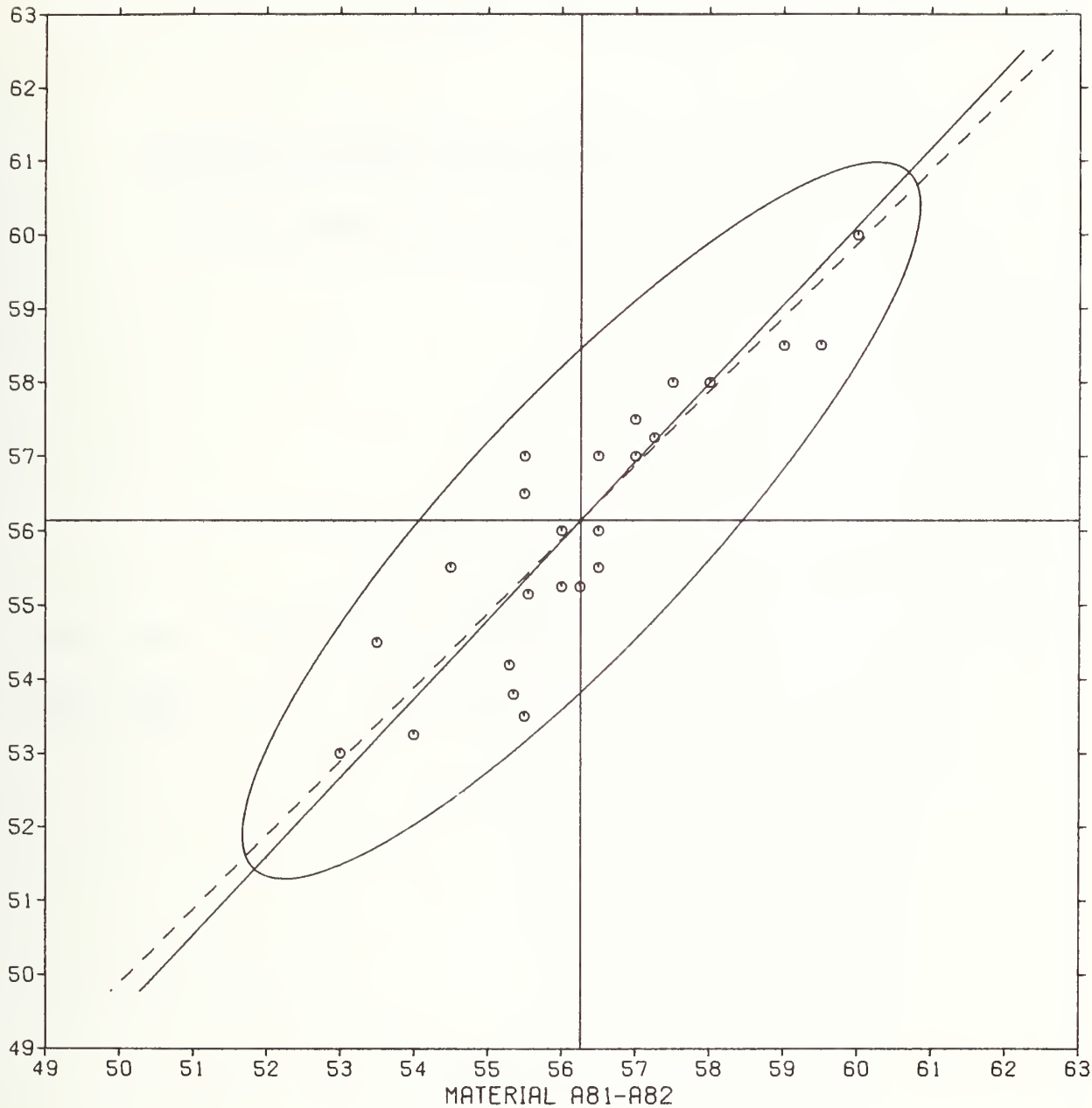
MATERIAL A81-A82

56.26 IRHD

MATERIAL A83-A84

56.14 IRHD

MATERIAL A83-A84





MOONEY VISCOSITY

NOTES

Materials R81 and R82 were the same rubber. Similarly, materials R83 and R84 were the same rubber. No sample preparation was required for materials R81 and R82 whereas, mill massing was required for materials R83 and R84.

V100 results were obtained at NBS on the manually closed viscometer used for determining the Mooney viscosities of the standard rubbers.

SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS			UNITS
					LABS	SHEETS	REPL	
MOONEY VISCOSITY	R81-R82	40	3	67.77	1.84	.17	.35	ML
	R83-R84	40	3	63.16	2.90	.53	.45	ML

PRECISION OF METHODS

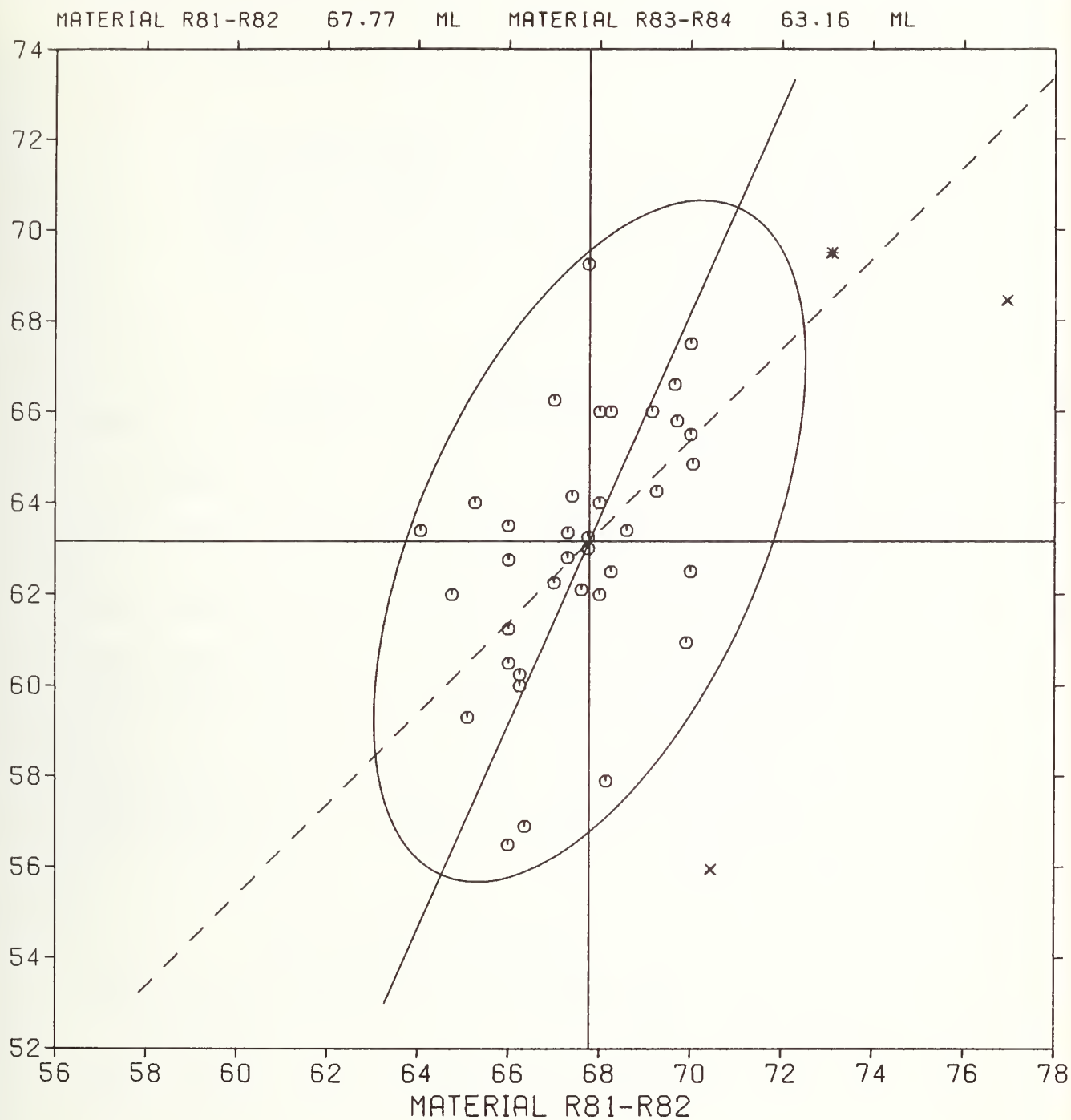
PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
					REPEAT	REPROD		REPEAT	REPROD
MOONEY VISCOSITY	R81-R82	3	3	67.77	.97	5.09	ML	1.4	7.5
	R83-R84	3	3	63.16	1.25	8.04	ML	2.0	12.7

INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
MOONEY VISCOSITY - ML

FEBRUARY 1978

MATERIAL R81-R82 BUTYL RUBBER				MATERIAL R83-R84 SBR				VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
LAB CODE	P	MEAN ML	% DEV	REL SDR	MEAN ML	% DEV	REL SDR		
V0077		66.00	-2.6	.72	56.50	-10.5	.87	01	
V0078	X	65.90	-2.8	1.62	50.50	-20.0	.96	01	
V0079	X	76.95	13.5	.82	68.45	8.4	4.21X	01	
V0080	X	70.45	4.0	1.37	55.95	-11.4	2.32	01	
V0083		69.25	2.2	.41	64.25	1.7	.64	01	
V0085		67.60	-.3	.16	62.10	-1.7	1.34	01	
V0090		69.15	2.0	.66	66.00	4.5	3.87X	01	
V0092		68.00	.3	1.64	66.00	4.5	1.28	01	
V0095		66.00	-2.6	1.83	62.75	-.7	1.43	01	
V0100		68.25	.7	.36	62.50	-1.0	.00	01	
V0111		65.10	-3.9	.65	59.30	-6.1	.34	01	
V0117		67.00	-1.1	1.12	62.25	-1.4	1.40	01	
V0122		64.75	-4.5	1.12	62.00	-1.8	.96	01	
V0128		66.00	-2.6	.82	63.50	.5	.64	01	
V0144		69.70	2.8	1.23	65.80	4.2	.39	01	
V0146		70.00	3.3	2.46X	67.50	6.9	.32	01	
V0148		73.10	7.9	.87	69.50	10.0	1.16	01	
V0149		70.05	3.4	.92	64.85	2.7	.65	01	
V0150		69.90	3.1	.38	60.95	-3.5	1.62	01	
V0156		66.00	-2.6	2.17	61.25	-3.0	.85	01	
V0166		67.00	-1.1	1.91	66.25	4.9	1.84	01	
V0169		70.00	3.3	1.64	62.50	-1.0	1.28	01	
V0177		64.05	-5.5	1.17	63.40	.4	.36	01	
V0178		67.30	-.7	.30	62.80	-.6	.50	01	
V0182		67.75	-.0	.41	63.25	.1	1.17	01	
V0190		68.15	.6	.38	57.90	-8.3	.65	01	
V0206		66.25	-2.2	1.23	60.00	-5.0	2.25	01	
V0207		57.40	-.5	1.47	64.15	1.6	.89	01	
V0208		70.00	3.3	1.64	65.50	3.7	1.28	01	
V0211		68.00	.3	.41	62.00	-1.8	.00	01	
V0213		66.25	-2.2	.00	60.25	-4.6	.32	01	
V0214		65.25	-3.7	1.50	64.00	1.3	2.58X	01	
V0217		68.25	.7	.41	66.00	4.5	.00	01	
V0218		67.75	-.0	.41	63.00	-.3	.64	01	
V0220		69.65	2.8	1.08	66.60	5.4	1.33	01	
V0221		68.60	1.2	.76	63.40	.4	1.10	01	
V0223		67.75	-.0	.41	69.25	9.6	.64	01	
V0230		66.35	-2.1	1.80	56.90	-9.9	.56	01	
V0236		70.00	3.3	.00	62.50	-1.0	1.28	01	
V0238		66.00	-2.6	.82	60.50	-4.2	3.58X	01	
V0244		68.00	.3	3.06X	64.00	1.3	1.11	01	
V0250		68.00	.3	1.64	62.00	-1.8	.64	01	
V0251		67.30	-.7	1.57	63.35	.3	1.84	01	
67.77			* GR. MEAN *		63.16				3 TEST DETERMINATIONS
1.84			* SD MEANS *		2.90				40 LABORATORIES IN GRAND MEANS
.35			* AVER SDR *		.45				43 LABORATORIES REPORTING
ML			* UNIT *		ML				

MOONEY VISCOSITY





VULCANIZATION CHARACTERISTICS USING OSCILLATING DISK CURE METER

NOTES

Materials W81 and W82 werethe same rubber formulation. Similarly, materials W83 and W84 were alike.

V100 results were obtained at NBS using a Model TM-100 Monsanto Rheometer with a disk oscillating at $\pm 1^\circ$ amplitude and 1.7 hertz frequency.

All participants used Monsanto Rheometers operated at one degree amplitude and 1.7 hertz frequency.

SUMMARY OF ANALYSES

PROPERTY	MATERIAL	LABS INCL	LABS OMIT	GR. MEAN	STD DEVIATIONS			UNITS
					LABS	SHEETS	REPL	
SCORCH TIME	W81-W82	37	2	3.90	.27	.03	.06	MINUTES
	W83-W84	37	2	3.44	.27	.02	.06	MINUTES
CURE TIME (50% MH)	W81-W82	36	3	6.28	.33	.03	.08	MINUTES
	W83-W84	36	3	7.31	.46	.05	.06	MINUTES
CURE TIME (90% MH)	W81-W82	36	3	10.53	.51	.05	.13	MINUTES
	W83-W84	36	3	14.83	.96	.09	.13	MINUTES
MINIMUM TORQUE	W81-W82	33	6	5.11	.37	.03	.07	POUND-INCHES
	W83-W84	33	6	6.44	.41	.04	.07	POUND-INCHES
MINIMUM TORQUE	W81-W82	33	6	.5778	.0416	.0038	.0075	NEWTON-METERS
	W83-W84	33	6	.7275	.0468	.0046	.0084	NEWTON-METERS
MAXIMUM TORQUE	W81-W82	38	1	24.09	1.04	.08	.16	POUND-INCHES
	W83-W84	38	1	30.70	1.22	.18	.09	POUND-INCHES
MAXIMUM TORQUE	W81-W82	38	1	2.7217	.1173	.0088	.0177	NEWTON-METERS
	W83-W84	38	1	3.4684	.1378	.0203	.0105	NEWTON-METERS

PRECISION OF METHODS

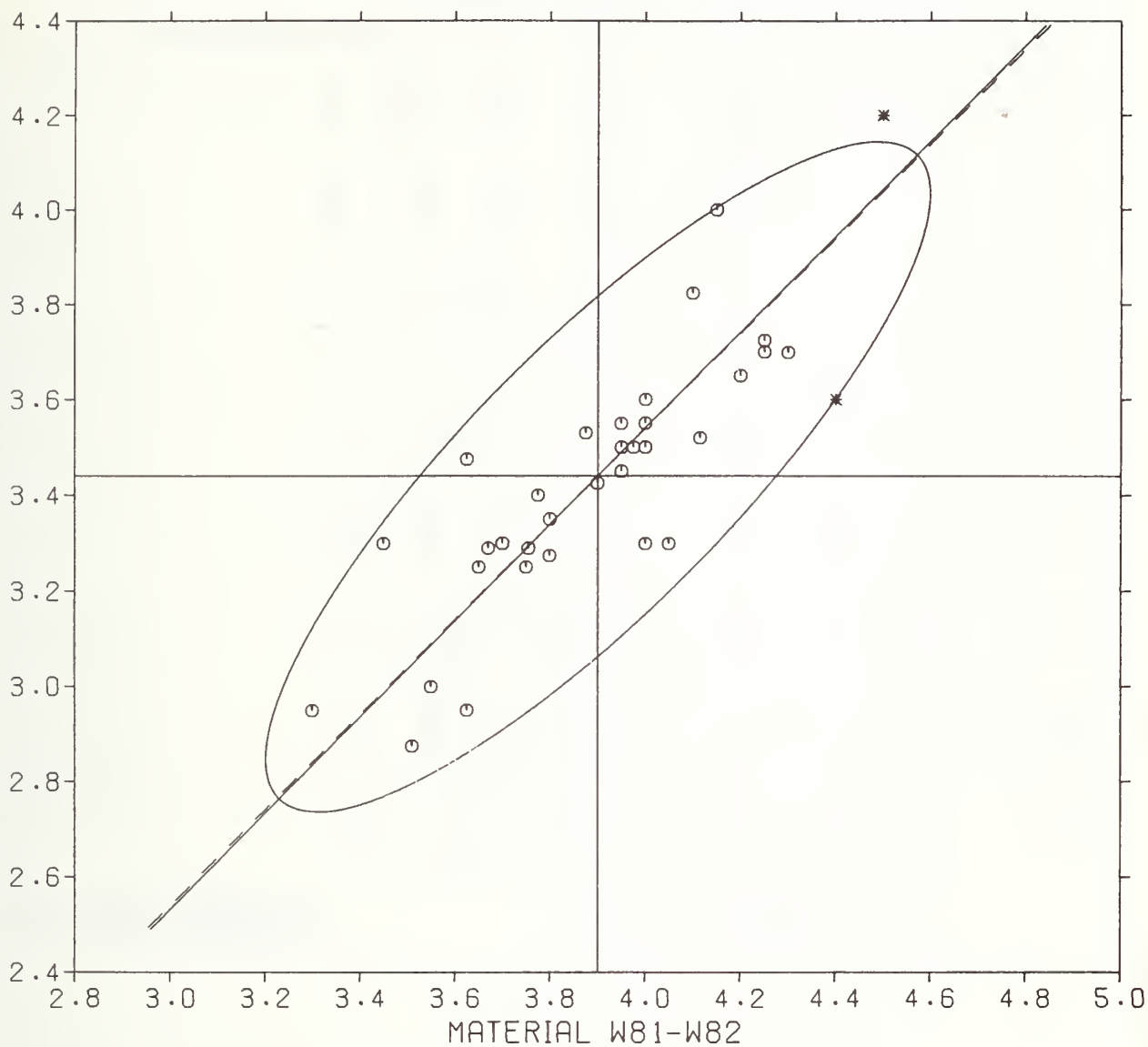
PROPERTY	MATERIAL	REPL CRP	REPL ASTM	GR. MEAN	ABSOLUTE		UNITS	PERCENT	
					REPEAT	REPROD		REPEAT	REPROD
SCORCH TIME	W81-W82	3	3	3.90	.16	.75	MINUTE	4.2	19.1
	W83-W84	3	3	3.44	.17	.75	MINUTE	4.9	21.9
CURE TIME (50% MH)	W81-W82	3	3	6.28	.21	.92	MINUTE	3.4	14.7
	W83-W84	3	3	7.31	.16	1.27	MINUTE	2.1	17.3
CURE TIME (90% MH)	W81-W82	3	3	10.53	.37	1.42	MINUTE	3.5	13.4
	W83-W84	3	3	14.83	.36	2.67	MINUTE	2.4	18.0
MINIMUM TORQUE	W81-W82	3	3	5.11	.18	1.02	LB-IN.	3.6	19.9
	W83-W84	3	3	6.44	.21	1.15	LB-IN.	3.2	17.8
MINIMUM TORQUE	W81-W82	3	3	.5778	.0207	.1151	N=M	3.6	19.9
	W83-W84	3	3	.7275	.0232	.1296	N=M	3.2	17.9
MAXIMUM TORQUE	W81-W82	3	3	24.09	.43	2.87	LB-IN.	1.8	11.9
	W83-W84	3	3	30.70	.26	3.38	LB-IN.	.8	11.0
MAXIMUM TORQUE	W81-W82	3	3	2.7217	.0491	.3248	N=M	1.8	11.9
	W83-W84	3	3	3.4684	.0292	.3816	N=M	.8	11.0

LAB CODE	F	MATERIAL W81-W82 COMMERCIAL TIRE TREAD			MATERIAL W83-W84 SBR			VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN MINUTE	% DEV	REL SDR	MEAN MINUTE	% DEV	REL SDR		
V0074A		3.51	-10.0	3.24X	2.87	-16.4	.00	01	
V0074B		3.77	-3.2	2.22	3.40	-1.2	1.02	01	
V0077		3.90	.0	1.61	3.42	-4.4	1.40	01	
V0078		4.50	10.3	.49	3.70	7.6	.94	01	
V0079		4.10	5.1	3.10X	3.82	11.2	.00	01	
V0083		4.25	9.0	.98	3.70	7.6	2.50X	01	
V0085		3.62	-7.1	.98	2.95	-14.2	.47	01	
V0090		4.25	9.0	.49	3.72	8.3	.38	01	
V0092		3.77	-3.2	.00	3.40	-1.2	1.18	01	
V0095 *		4.40	12.8	2.25	3.60	4.7	1.89	01	
V0100		4.00	2.6	.49	3.30	-4.1	.94	01	
V0117		3.75	-3.8	1.34	3.25	-5.5	.00	01	
V0120		4.11	5.5	3.04X	3.52	2.3	3.71X	01	
V0122		3.55	-9.0	.85	3.00	-12.8	1.29	01	
V0128		4.20	7.7	.85	3.65	6.1	.47	01	
V0144		3.67	-5.9	.34	3.25	-4.4	.62	01	
V0146		4.00	2.6	1.22	3.50	1.7	.94	01	
V0148	X	1.50	-61.5	.49	1.30	-62.2	.24	01	
V0149		3.97	1.9	1.31	3.50	1.7	.47	01	
V0150		3.45	-11.5	.98	3.30	-4.1	2.06	01	
V0152		3.80	-2.6	.00	3.35	-2.6	.00	01	
V0154		3.95	1.3	.49	3.45	.3	.82	01	
V0156		3.95	1.3	.49	3.50	1.7	1.49	01	
V0158		3.80	-2.6	1.22	3.27	-4.8	.94	01	
V0161		3.70	-5.1	.98	3.30	-4.1	.47	01	
V0166		4.00	2.6	.98	3.55	3.2	.94	01	
V0169		3.65	-6.4	.98	3.25	-5.5	.82	01	
V0182		3.70	-5.1	.24	3.30	-4.1	.65	01	
V0207 *		4.50	15.4	.85	4.20	22.1	1.42	01	
V0208		3.75	-3.7	1.39	3.29	-4.4	.71	01	
V0211		3.95	1.3	.98	3.55	3.2	.94	01	
V0213		3.62	-7.1	1.96	3.47	1.0	1.08	01	
V0214	X	.90	-76.9	2.67X	.80	-76.7	1.89	01	
V0217		4.15	6.4	2.94X	4.00	16.3	.00	01	
V0218		3.95	1.3	.49	3.50	1.7	1.29	01	
V0220		3.30	-15.4	2.61X	2.95	-14.2	1.29	01	
V0221		4.00	2.6	.49	3.60	4.7	1.42	01	
V0238		4.05	3.8	2.61X	3.30	-4.1	.00	01	
V0243		3.87	-4.6	1.06	3.53	2.6	.63	01	
		3.90	-	GR. MEAN -	3.44	-			3 TEST DETERMINATIONS
		.27	-	SD MEANS -	.27	-			37 LABORATORIES IN GRAND MEANS
		.06	-	AVER SDR -	.06	-			39 LABORATORIES REPORTING
		MINUTE	-	UNIT -	MINUTE	-			

SCORCH TIME

MATERIAL W81-W82 3.90 MINUTE MATERIAL W83-W84 3.44 MINUTE

MATERIAL W83-W84



INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
CURE TIME (50% MH) - MINUTES

MARCH 1978

LAB CODE	P	MATERIAL W81-W82 COMMERCIAL TIRE TREAD			MATERIAL W83-W84 SBR			VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN MINUTE	% DEV	REL SDR	MEAN MINUTE	% DEV	REL SDR		
V0074A	*	5.71	-9.1	2.30	6.11	-16.4	2.59X	01	
V0074B		6.35	1.1	1.69	7.42	1.6	.93	01	
V0077		6.39	1.7	1.25	7.50	2.6	1.25	01	
V0078	X	23.75	99.9	1.52	29.55	99.9	1.02	01	
V0079	*	6.60	5.1	2.66X	8.32	13.9	.77	01	
V0083		6.90	9.9	2.03	7.95	8.8	3.89X	01	
V0085		6.05	-3.7	1.51	6.47	-11.4	.26	01	
V0090		6.73	7.2	.23	7.70	5.3	.51	01	
V0092		6.25	-5	.19	7.27	-5	.51	01	
V0095		6.45	2.7	.38	7.20	-1.5	1.35	01	
V0100		6.30	.3	1.52	7.15	-2.2	1.02	01	
V0117		5.90	-6.1	.66	7.10	-2.9	.51	01	
V0120		6.51	3.7	3.41X	7.64	4.5	10.51X	01	
V0122		5.95	-5.3	.76	6.95	-4.9	1.53	01	
V0128		6.35	1.1	.38	7.50	2.6	.51	01	
V0144		5.91	-5.8	.87	6.96	-4.8	1.26	01	
V0146		6.50	3.5	1.04	7.45	1.9	1.02	01	
V0148	X	15.35	99.9	3.81X	19.27	99.9	1.14	01	
V0149		6.55	4.3	2.01	7.62	4.3	1.02	01	
V0150	*	5.50	-12.4	2.03	6.70	-8.3	2.85X	01	
V0152		6.20	-1.3	.76	7.20	-1.5	.00	01	
V0154		6.40	1.9	.38	7.42	1.6	.51	01	
V0156		6.40	1.9	.00	7.40	1.2	.89	01	
V0158		6.02	-4.1	.95	6.92	-5.3	1.02	01	
V0161		6.10	-2.9	.76	6.90	-5.6	1.02	01	
V0166		6.50	3.5	.76	7.50	2.6	1.40	01	
V0169		6.00	-4.5	1.14	7.10	-2.9	2.85X	01	
V0182		5.97	-4.9	.33	7.05	-3.6	1.02	01	
V0207	*	6.25	-5	3.31X	7.90	8.1	4.50X	01	
V0208		6.43	2.4	.59	7.26	-6	1.07	01	
V0211		6.25	-5	.76	7.20	-1.5	1.91	01	
V0213		6.50	3.5	.38	7.65	4.7	1.14	01	
V0214	X	16.95	99.9	.38	20.70	99.9	8.69X	01	
V0217		6.95	10.7	1.14	8.10	10.8	1.02	01	
V0218		6.40	1.9	1.04	7.55	3.3	1.40	01	
V0220		5.50	-12.4	1.14	6.45	-11.8	1.40	01	
V0221		6.50	3.5	.38	7.60	4.0	1.40	01	
V0238		6.50	3.5	1.71	7.60	4.0	.51	01	
V0243		6.30	.3	.95	7.30	-1	.82	01	
		6.28	= GR. MEAN =			7.31	3 TEST DETERMINATIONS		
		.33	= SD MEANS =			.46	36 LABORATORIES IN GRAND MEANS		
		.08	= AVER SDR =			.06	39 LABORATORIES REPORTING		
		MINUTE	= UNIT =			MINUTE			

CURE TIME (50% MH)

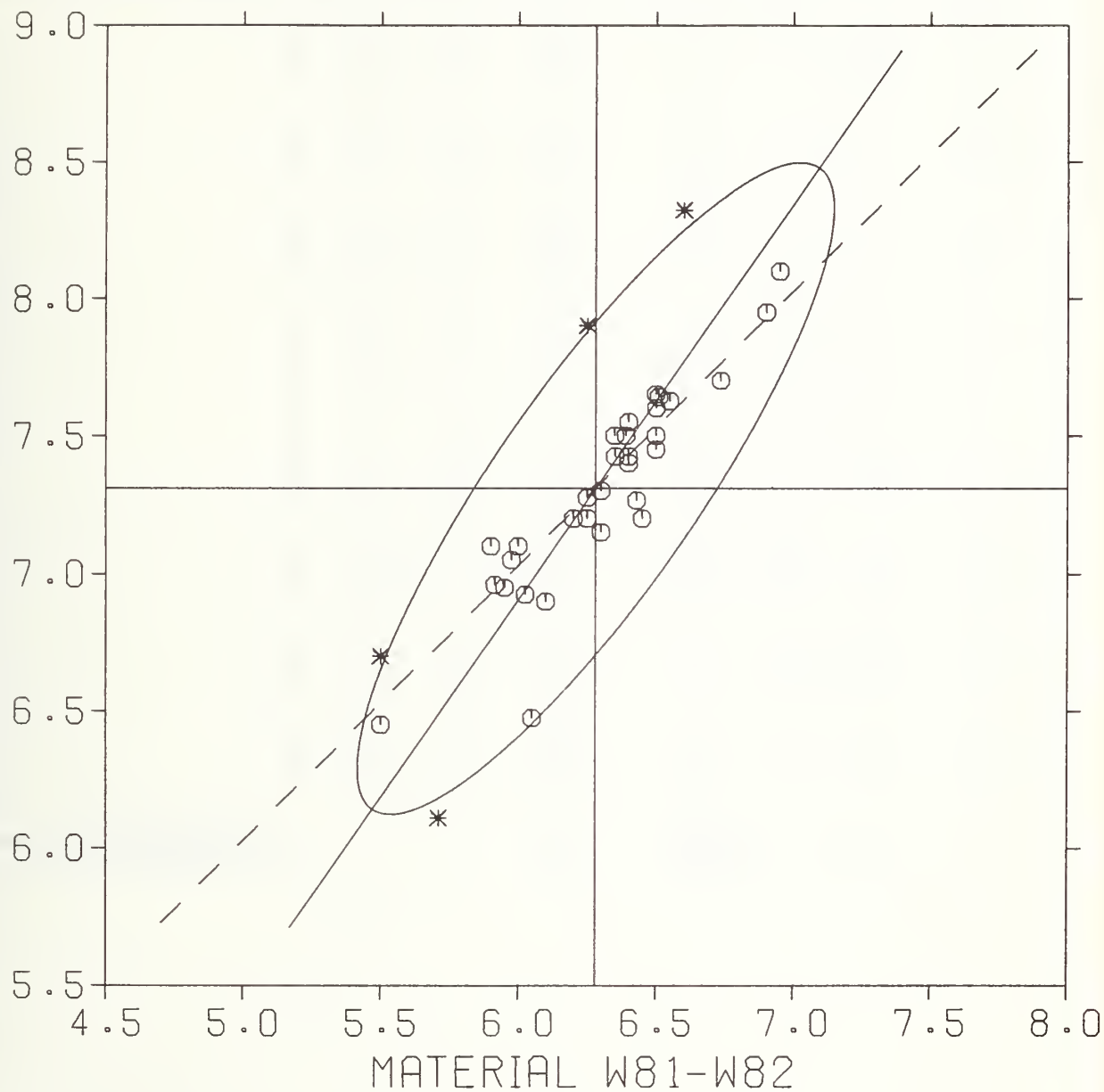
MATERIAL W81-W82

6.28 MINUTE

MATERIAL W83-W84

7.31 MINUTE

MATERIAL W83-W84



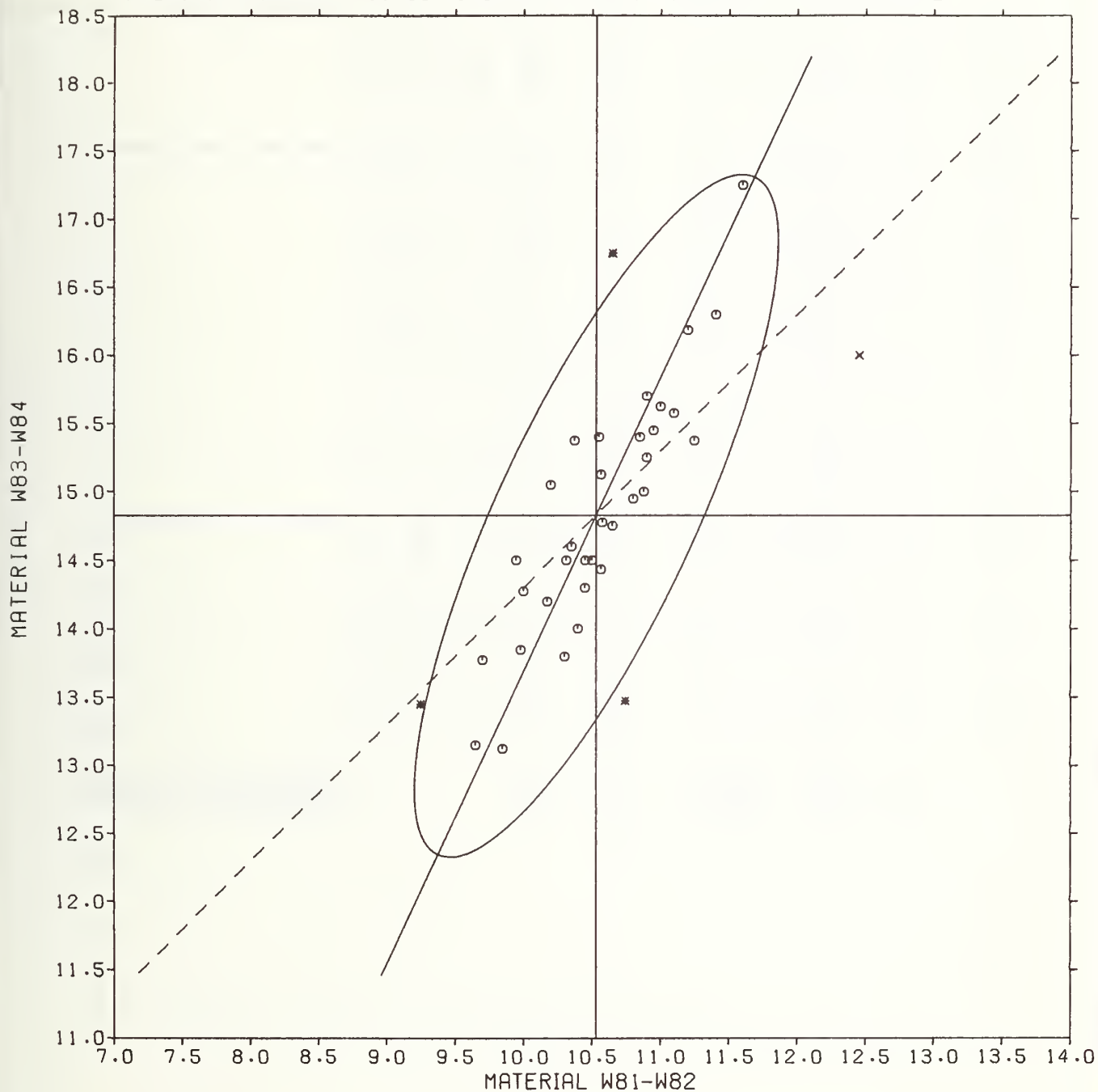
LAB CODE	P	MATERIAL W81-W82 COMMERCIAL TIRE TREAD			MATERIAL W83-W84 SBR			VAR CODE	INSTRUMENT, UNIT, OR OTHER VARIATION
		MEAN MINUTE	% DEV	REL SDR	MEAN MINUTE	% DEV	REL SDR		
V0074A		9.70	-7.9	6.39X	13.77	-7.1	1.75	01	
V0074B		10.87	3.3	1.50	15.00	1.2	.22	01	
V0077		10.56	.3	.72	15.12	2.0	1.30	01	
V0078	X	12.45	18.3	.43	16.00	7.9	.39	01	
V0079	*	10.65	1.2	3.24X	16.75	13.0	1.12	01	
V0083		11.40	8.3	3.68X	16.30	9.9	2.83X	01	
V0085		9.85	-6.4	1.31	13.12	-11.5	.75	01	
V0090		11.25	6.9	.92	15.37	3.7	.99	01	
V0092		10.31	-2.0	.66	14.50	-2.2	1.12	01	
V0095		10.40	-1.2	.99	14.00	-5.6	.67	01	
V0100		10.45	-.7	1.62	14.30	-3.5	.45	01	
V0117		10.35	-1.7	.99	14.60	-1.5	1.57	01	
V0120		11.20	6.4	2.60X	16.18	9.2	13.57X	01	
V0122		10.55	.2	.37	15.40	3.9	1.79	01	
V0128		10.20	-3.1	.43	15.05	1.5	.22	01	
V0144		9.98	-5.2	.38	13.85	-6.6	.29	01	
V0146		10.65	1.2	1.50	14.75	-.5	.00	01	
V0148	X	23.85	99.9	3.34X	29.41	98.4	.25	01	
V0149		11.10	5.4	.96	15.57	5.1	1.25	01	
V0150		9.65	-8.3	1.83	13.15	-11.3	2.02	01	
V0152		10.50	-.3	.21	14.50	-2.2	.00	01	
V0154		10.90	3.5	.89	15.70	5.9	.79	01	
V0155		10.57	.4	.19	14.77	-.3	.92	01	
V0158		10.17	-3.4	1.26	14.20	-4.2	.78	01	
V0161		10.30	-2.2	.43	13.80	-6.9	1.20	01	
V0166		10.80	2.6	1.17	14.95	.8	.90	01	
V0169		9.95	-5.5	1.55	14.50	-2.2	1.43	01	
V0182		10.00	-5.0	1.02	14.27	-3.7	.49	01	
V0207		11.60	10.2	1.72	17.25	16.4	1.40	01	
V0208	*	10.74	2.1	2.43X	13.47	-9.1	3.78X	01	
V0211		10.45	-.7	.43	14.50	-2.2	.90	01	
V0213		10.37	-1.5	.96	15.37	3.7	.97	01	
V0214	X	24.25	99.9	.21	29.95	99.9	1.12	01	
V0217		10.90	3.5	1.71	15.25	2.9	.00	01	
V0218		10.95	4.0	1.41	15.45	4.2	1.12	01	
V0220	*	9.25	-12.1	1.41	13.45	-9.3	.82	01	
V0221		10.85	3.1	.00	15.40	3.9	.45	01	
V0238		11.00	4.5	1.07	15.62	5.4	1.53	01	
V0243		10.56	.3	.38	14.43	-2.6	.80	01	
		10.53	GR. MEAN		14.83	3 TEST DETERMINATIONS 36 LABORATORIES IN GRAND MEANS 39 LABORATORIES REPORTING			
		.51	SD MEANS		.96				
		.13	AVER SDR		.13				
		MINUTE	UNIT		MINUTE				

CURE TIME (90% MH)

MATERIAL W81-W82

10.53 MINUTE MATERIAL W83-W84

14.83 MINUTE



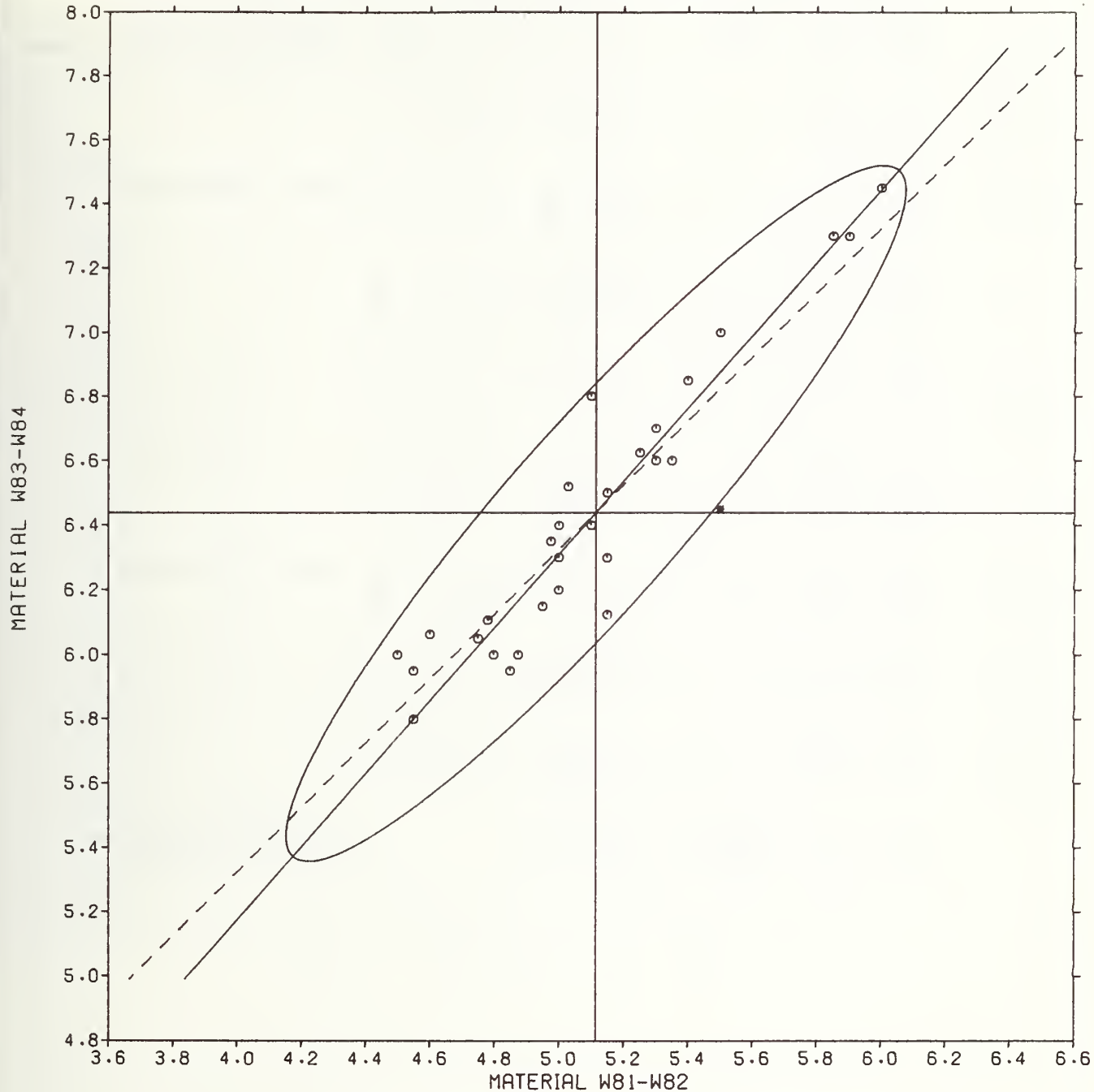
INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
MINIMUM TORQUE - POUND-INCHES

MARCH 1973

MATERIAL W81-W82 COMMERCIAL TIRE TREAD					MATERIAL W83-W84 SBR					INSTRUMENT, UNIT, OR OTHER VARIATION
LAB CODE	P	MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	
V0074A		5.00	.5649	-2.2	1.31	6.40	.7231	-6	1.09	01
V0074B		5.25	.5932	2.7	.44	6.62	.7486	2.9	1.03	01
V0077		4.97	.5621	-2.7	.52	6.35	.7175	-1.4	1.29	01
V0078	X	10.65	1.2033	99.9	.44	7.15	.8079	11.1	.78	01
V0079		4.75	.5367	-7.1	3.93X	6.05	.6836	-6.0	.85	01
V0083		5.30	.5988	3.6	.87	6.60	.7457	2.5	.78	01
V0085		4.60	.5200	-10.0	.39	6.06	.6850	-5.8	.00	40
V0090		4.80	.5424	-6.1	.87	6.00	.6779	-6.8	.00	01
V0092	*	5.50	.6214	7.5	.00	6.45	.7288	.2	1.06	01
V0095	X	5.75	.6497	12.4	5.56X	8.10	.9152	25.8	1.45	01
V0100		5.10	.5762	-6.3	.44	6.40	.7231	-6	.00	01
V0117		5.30	.5988	3.6	1.19	6.70	.7570	4.1	2.96X	01
V0120		5.50	.6214	7.5	1.31	7.00	.7909	8.7	1.79	01
V0122		6.00	.6779	17.3	.87	7.45	.8418	15.7	1.06	01
V0128		5.15	.5819	.7	.44	6.50	.7344	1.0	.39	01
V0144		5.90	.6666	15.4	1.75	7.30	.8248	13.4	2.96X	01
V0146		4.50	.5085	-12.0	4.36X	6.00	.6779	-6.8	3.57X	01
V0148		5.25	.5932	2.7	4.48X	6.62	.7486	2.9	2.06	01
V0149		5.15	.5819	.7	1.41	6.12	.6921	-4.9	.39	01
V0150	X	7.25	.8192	41.8	4.80X	9.00	1.0169	39.8	1.95	01
V0152		4.55	.5141	-11.0	1.75	5.80	.6553	-9.9	.00	01
V0154		5.00	.5649	-2.2	.87	6.20	.7005	-3.7	.39	01
V0155		5.15	.5819	.7	.44	6.30	.7118	-2.1	.00	01
V0159		5.35	.6045	4.6	1.19	6.60	.7457	2.5	1.03	01
V0161		4.95	.5593	-3.2	1.19	6.15	.6949	-4.5	1.06	01
V0166		5.00	.5649	-2.2	.44	6.30	.7118	-2.1	1.03	01
V0169		4.78	.5400	-6.5	1.16	6.11	.6900	-5.1	1.15	40
V0182		4.85	.5480	-5.2	.87	5.95	.6723	-7.6	1.45	01
V0207	X	7.35	.8305	43.7	1.51	8.60	.9717	33.6	1.70	01
V0208		5.03	.5683	-1.6	.00	6.52	.7367	1.3	.00	01
V0211		4.55	.5141	-11.0	.87	5.95	.6723	-7.6	.78	01
V0213	X	13.30	1.5028	99.9	2.78X	15.00	1.6948	99.9	.73	01
V0214	X	7.80	.8813	52.5	1.19	9.20	1.0395	42.9	13.04X	01
V0217		5.10	.5762	-6.3	6.00X	6.80	.7683	5.6	1.55	01
V0218		5.15	.5819	.7	1.19	6.50	.7344	1.0	.73	01
V0220		5.15	.5819	.7	1.19	6.50	.7344	1.0	1.17	01
V0221		5.85	.6610	14.4	1.75	7.30	.8248	13.4	.39	01
V0238		4.87	.5508	-4.7	1.09	6.00	.6779	-6.8	.00	01
V0243		5.40	.6101	5.6	1.19	6.85	.7740	6.4	.39	01
		5.11	.5778	- GR. MEAN -		6.44	.7275			3 TEST DETERMINATIONS
		.37	.0416	- SD MEANS -		.41	.0468			33 LABORATORIES IN GRAND MEANS
		.07	.0075	- AVER SDR -		.07	.0084			39 LABORATORIES REPORTING
		LB-IN.	N-M	- UNIT -		LB-IN.	N-M			

MINIMUM TORQUE

MATERIAL W81-W82 5.11 LB-IN. MATERIAL W83-W84 6.44 LB-IN.



INTERLABORATORY PROGRAM ON EVALUATION OF RUBBER
MAXIMUM TORQUE - POUND-INCHES

MARCH 1978

MATERIAL W81-W82						MATERIAL W83-W84						INSTRUMENT, UNIT, OR OTHER VARIATION
COMMERCIAL TIRE TREAD						SBR						
LAB CODE	F	MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	MEAN LB-IN.	MEAN N-M	% DEV	REL SDR	VAR CODE		
V0074A	*	23.72	2.6807	-1.5	.88	32.45	3.6665	5.7	1.00	01	ORIGINAL IN NEWTON-METER	
V0074B		24.25	2.7400	.7	.48	30.70	3.4688	.0	.94	01		
V0077		23.30	2.6327	-3.3	1.14	29.60	3.3445	-3.6	1.13	01		
V0078		25.25	2.8530	4.8	.74	32.05	3.6213	4.4	.62	01		
V0079		23.12	2.6129	-4.0	3.31X	30.00	3.3897	-2.3	.00	01		
V0083		25.05	2.8304	4.0	2.05	31.90	3.6044	3.9	1.93	01	ORIGINAL IN NEWTON-METER	
V0085		23.10	2.6101	-4.1	.71	29.96	3.3851	-2.4	.72	40		
V0090		23.45	2.6496	-2.6	.32	29.55	3.3389	-3.7	.15	01		
V0092		25.92	2.9293	7.6	.99	32.10	3.6270	4.6	.62	01		
V0095	*	23.50	2.6553	-2.4	4.16X	28.00	3.1637	-8.8	1.75	01		
V0100		24.55	2.7739	1.9	.18	31.60	3.5705	2.9	.00	01	ORIGINAL IN NEWTON-METER	
V0117		24.35	2.7513	1.1	1.21	31.50	3.5592	2.6	.93	01		
V0120		25.05	2.8304	4.0	1.00	32.55	3.6778	6.0	2.23	01		
V0122		25.20	2.8473	4.6	2.42X	31.90	3.6044	3.9	1.69	01		
V0128		22.75	2.5705	-5.6	.82	30.45	3.4405	-.8	.31	01		
V0144		25.00	2.8248	3.8	.37	31.80	3.5931	3.6	3.09X	01	ORIGINAL IN NEWTON-METER	
V0146		22.45	2.5366	-6.8	.50	28.90	3.2654	-5.9	.62	01		
V0148		25.45	2.8756	5.7	2.18	31.95	3.6100	4.1	.31	01		
V0149		23.67	2.6750	-1.7	1.54	29.77	3.3643	-3.0	.77	01		
V0150		25.00	2.8248	3.8	1.84	30.50	3.4462	-.6	3.09X	01		
V0152		23.00	2.5588	-4.5	.00	29.30	3.3106	-4.5	.31	01	ORIGINAL IN NEWTON-METER	
V0154		24.00	2.7118	-.4	.18	30.45	3.4405	-.8	.31	01		
V0156		23.20	2.6214	-3.7	.00	29.40	3.3219	-4.2	1.35	01		
V0158		24.17	2.7315	.4	.96	30.80	3.4801	.3	.54	01		
V0161		22.65	2.5592	-6.0	.81	29.20	3.2993	-4.9	1.15	01		
V0166		23.50	2.6553	-2.4	.37	30.50	3.4462	-.6	.62	01	ORIGINAL IN NEWTON-METER	
V0169		23.81	2.6901	-1.2	1.07	30.14	3.4051	-1.8	.82	40		
V0182		23.85	2.6948	-1.0	1.33	31.30	3.5366	2.0	1.07	01		
V0207		26.05	2.9434	8.1	1.44	32.85	3.7117	7.0	.85	01		
V0208		25.33	2.8620	5.2	1.73	31.10	3.5140	1.3	4.61X	01		
V0211		22.35	2.5253	-7.2	.98	28.60	3.2315	-6.8	.31	01	ORIGINAL IN NEWTON-METER	
V0213	X	47.00	5.3105	95.1	2.39	58.75	6.6382	91.4	4.64X	01		
V0214		26.05	2.9434	8.1	.18	32.15	3.6326	4.7	1.93	01		
V0217		23.70	2.6779	-1.6	2.08	30.30	3.4236	-1.3	1.86	01		
V0218		23.50	2.6553	-2.4	.66	30.60	3.4575	-.3	1.44	01		
V0220		23.55	2.6609	-2.2	4.22X	30.20	3.4123	-1.6	2.48X	01	ORIGINAL IN NEWTON-METER	
V0221		25.00	2.8248	3.8	.00	32.10	3.6270	4.6	.93	01		
V0238		22.87	2.5846	-5.0	.92	29.25	3.3050	-4.7	1.55	01		
V0243		24.60	2.7796	2.1	1.33	31.00	3.5027	1.0	1.24	01		
		24.09	2.7217	GR. MEAN =		30.70	3.4684	3 TEST DETERMINATIONS				
		1.04	.1173	SD MEANS =		1.22	.1378	38 LABORATORIES IN GRAND MEANS				
		.16	.0177	AVER SDR =		.09	.0105	39 LABORATORIES REPORTING				
		LB-IN.	N-M	UNIT =		LB-IN.	N-M					

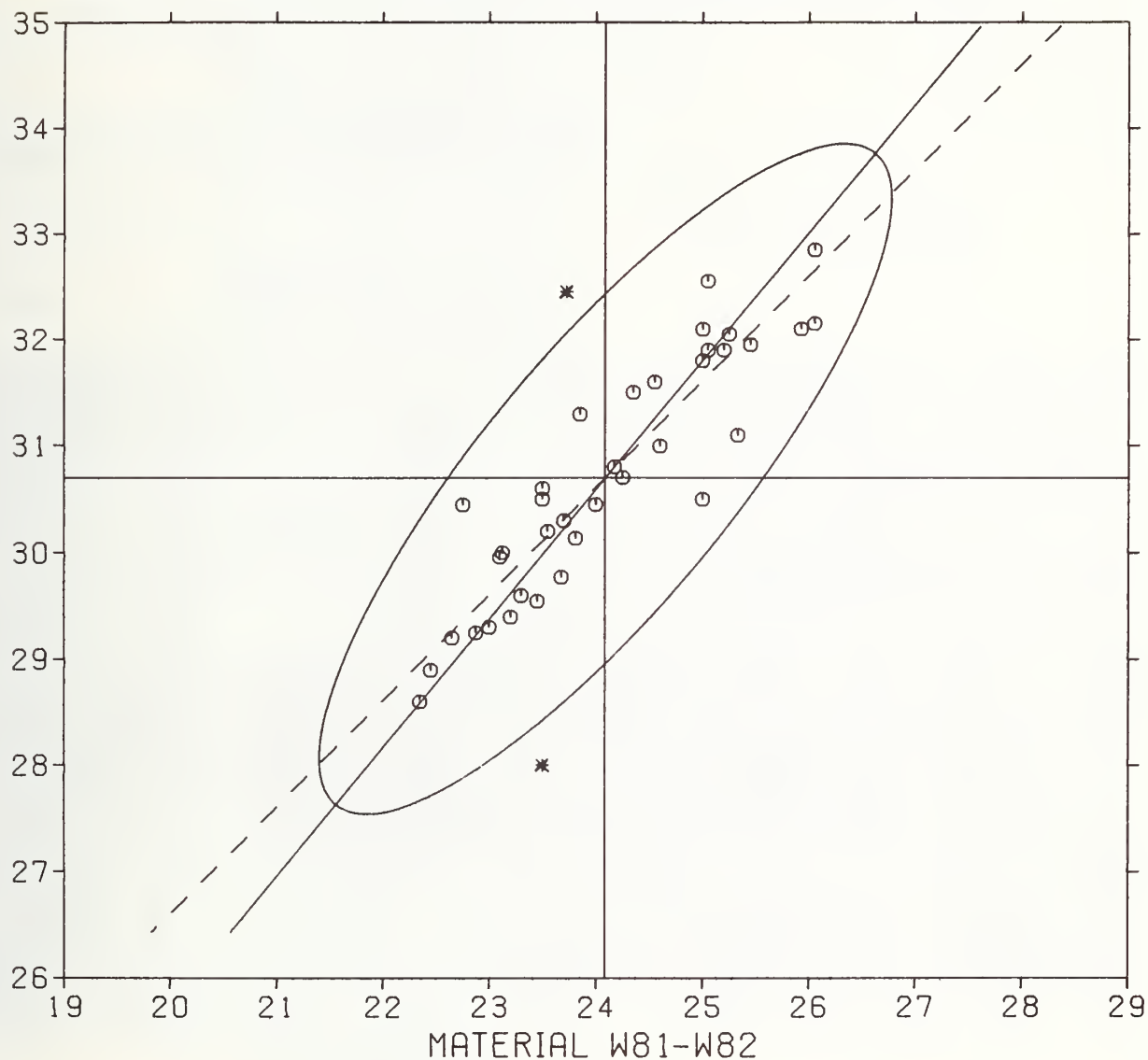
MAXIMUM TORQUE

MATERIAL W81-W82

24.09 LB-IN.

MATERIAL W83-W84

30.70 LB-IN.



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